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(71) Applicant
Raymond Daniel Le-Roy Harvey
Kendal Lodge
The Broadway
Totland Bay
Isle of Wight
(72) Inventor
Raymond Daniel Le-Roy Harvey
(74) Agents
D Young & Co
10 Staple Inn
London WC1V 7RD

(54) **Cooling blown extruded tubular film**

(57) A tube (4) of plastics material extruded by an extruder (1), is inflated by compressed air from a nozzle (6) and the expanded tube (7) is passed between pinch rollers (8) to a storage roll (9). To expedite cooling of the inflated tube (7), the tube (7) is surrounded by a column (10) and cooled air from a fan/cooler unit (12) is supplied through a hose (13) to an annular space (11) between the tube (7) and the column (10) and extracted from the space (11) by a hose (14) and returned to the unit (12). Irises may be provided at the top and bottom of the column (10) to seal the ends of the space (11) and plenums at the top and bottom of the column (10) preferably cause a toroidal air flow in the space (11).

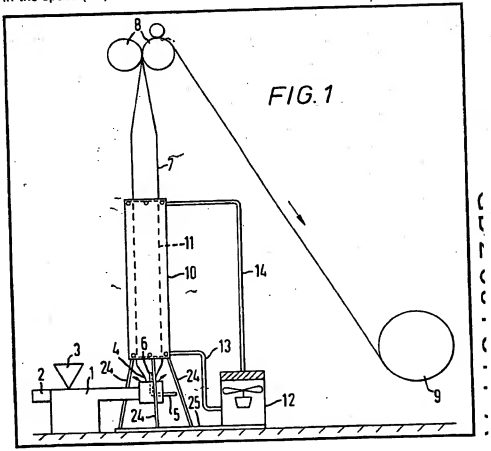
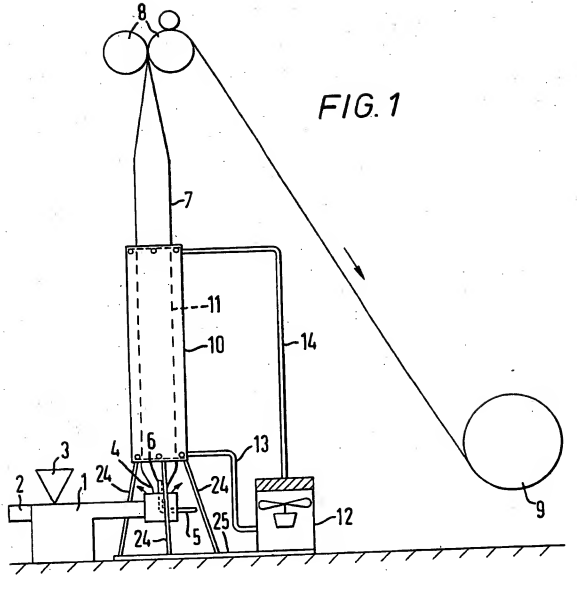


FIG. 1

FIG. 1



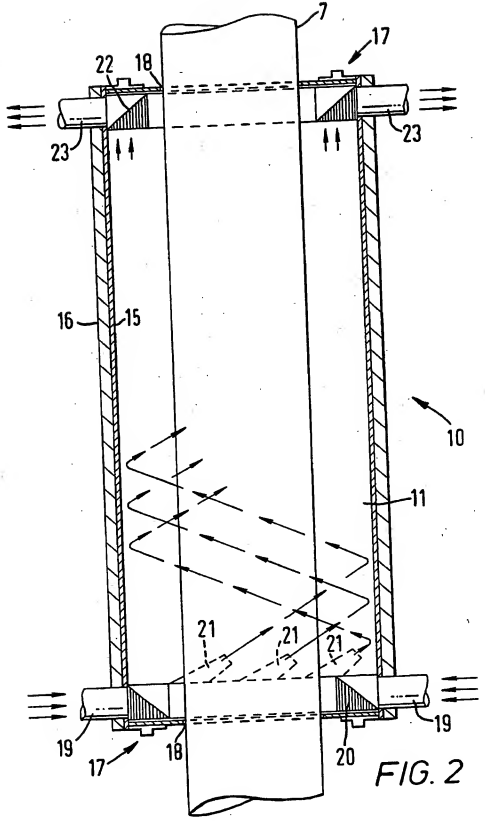


FIG. 2

SPECIFICATION

Improvements relating to cooling blown extruded tubuler film

The invention relates to the formation of blown extruded tubuler film and particularly to cooling thereof.

Plastics film, particularly polythene film, can be formed by extruding e tube of polythene, for exemple between 2" and 4" in diameter, closing of the end of the tube first extruded and supplying eir under pressure to within the tube to expand the tube to a much larger diameter, for example 10' diameter, to form film of a desired thickness. Usually the tube is extruded in e vertically upward direction and the extruded tube, expanded by eir pressure, is pulled upwardly and eventually passes between a pair of pinch rollers which prevent the eir within the tube from eseeping, the tube being conveyed from the pinch rollers in a "laid flat" condition and rolled up for storage in thet condition or slit end opened out and stored in single thickness on e roll.

Due to the high temperature at which the plastics tube leaves the extruder, it is necessary for the pinch rollers to be a considerable height above the extruder to allow the tubuler film to cool sufficiently so that as it passes therebetween it does not stick to the pinch rolls and one side of the tube does not stick to the other side. The required distance between the extruder end the pinch rolls may be as much as 40'.

Various ettempts have been mede to cool the film more quickly so that the height of the pinch rolls above the extruder cen be reduced end these have generally comprised cooling of the air within the tubular film. Thus a cooling unit hes been mounted on the core of the extruder, so that it is located within the tubular film and the air within the tubular film has been passed through the cooling unit to cool it. The cooling unit was supplied with iced water supplied through the core of the extruder and it hes even been proposed to supply the cooling unit with e refrigerant which chenges stete in its working cycle, *i.e.* between a gas end a liquid. The core of the extruder is however at high temperature and most of the cooling effect is therefore lost before the coolant reaches the cooling unit.

Ambient temperature is very significant in such a method of producing film by blowing an extruded tube such that the production rate can be considerebly increased on e night shift compared to a day shift due to the lower ambient temperature and winter production retes can be higher than summer production rates.

According to one aspect of the invention, e method of cooling en expanded tube of extruded plastics meterial comprises surrounding at least a portion of the expanded tube, intermediate the position of extrusion of the extruded tube of the plastics material end pinch rolls between which the cooled end expanded tube is passed, by a tubular column; supplying cooling air to an annular space between the tubular column end the expanded tube; end sealing et least one of the ends of the said annular space to reduce leakage of cooling air therefrom.

According to a further aspect of the invention, cooling apparatus for cooling an expended tube of extruded plestics material comprises e tubuler column to surround an expanded tube of extruded plestics material, means to supply cooling air to an annular space between the column and the expanded tube and at least one end seal on the column to close off said annular space at a position or positions adjacent one or both ends of the column.

Preferably an end seal is provided et each end of the column and comprises an adjustable iris, that is to say en ennuler member formed of a plurality of parts which are relatively movable such that the inner diameter of the annular member is adjustable in size.

The means to supply cooling air to the annuler spece preferably comprise e fen to ceuse flow of eir through a cooler unit and hoses connecting the cooler unit to opposite ends of the column. At the lower end of the column, ebove the lower adjustable iris thereof, a plenum is provided with upwerdly directed outlets, the outlets being so angled thet jets of air flowing from the plenum into the annular spece ceuse a toroidal flow of air in the annuler space in an upward direction, e collector being provided at the upper end to extract the air from the column and feed it back to the fan cooler unit. The column could for example, be formed of sheet steel end if desired could be split longitudinally end provided in two relatively hinged together parts such that it could be opened up, particularly to allow the extruded tube to be drawn therethrough when first starting an extruding operation. Preferably the column is mounted on legs which ere edjustable in height end may be mounted as a wheeled unit together with the fan cooler whereby it can relatively easily be moved to provide cooling for different extruders. The column may be provided with an insulating jacket to prevent undesirable heat gein thereof from the surrounding atmospheric air.

The direction of air flow in the column could be the same as or opposite to the direction of movement of the extruded expended film through the column, as desired for particular operating circumstances.

Further feetures of the invention ere illustrated in the eccompanying diagrammetic drawings, in which:—

Figure 1 is an elevation of en extruder producing expanded tubuler plastics film and

cooparating with apperatus eccording to said further espect of the invention; end

Figure 2 is a mora deteilad view of a middle part of Fig. 1.

Referring to the drawings, en extruder 1 has a drive motor 2 to rotata an extruder screw (not shown) which plasticises plastics meterial fed to e feed hopper 3 end forces the plasticised matarial through an annuler extrusion orifice as an extruded tube 4 of the plastics material. Comprassed air can be suppliad to a feed pipe 5 to pass through the core of the extruder outlet to a nozzle 6 whereby compressad air can be supplied to the interior of the tuba 4. By sealing the end of the tube 4 first extruded, the tuba 4 can ba expanded to a diameter considerably greater than the diametar et which it wes extruded to form e larger diemeter tube 7 of film which, when cooled, can pass between a pair of pinch rollers 8 end be drawn downwardly and rolled up for storaga on e real 9.

To expedite cooling of the expanded tubular film 7 after leeving the outlet orifice of the extrudar 1 and before being drawn between the pinch rollers 8, the tube 7 is passed through a column 10 which surrounds the tube 7 and has seals at its ands to seal off the annular space 11 between the tube 7 and the column 10. A cooler/blower unit 12 feeds air through a hosa 13 to the lower end of the column 10 end withdraws air from the upper end of the column 10 through a hose 14.

Referring now to Fig. 2, the column 10 has an inner annuler sheet steel wall 15 provided with an outer heat insulating jacket 16. An annular iris 17 is provided at each end of the column 10 and each iris 17 is adjustable so that the diameter of the orifice therein can be made only slightly larger than the diameter of the expanded tube 7 passing therethrough so that the inner edge 18 of the iris lies closely adjacent the outer face of the expanded film 7 around the periphery thereof.

The supply hose 13 shown in Fig. 1 is branchad end fed to two tubular inlets 19 at tha lower end of the column 10, the tubuler inlets 19 feeding a plenum 20 in the lower and of the column 10, the plenum 20 has a plurality of angled discharge nozzles 21 such that air discharged therafrom passes in a helical toroidal path upwardly through the ennular space 11 between the outer surface of the expanded tubuler film 7 and the inner surface of the sheet steal wall 15 of the column 10. In its upper end tha column 10 has a further plenum 22 which collects the eir passing upwardly through the annular space 11 end discharges it through a pair of discharge pipes 23, which pipes 23 merge and are coupled to the return pipe 14 shown in Fig. 1 to feed air back to the cooler/blower unit 12. While an upwardly spiralling flow of air is shown in Fig. 2, it will be appreciated that the column 10 could if desired be invarted so thet it would have a downward flow of air therethrough, *i.e.* a flow of air against the direction of movement of the expanded extruded tube 7. Fig. 1 shows that the column 10 is mounted on legs 24, which legs 24 would preferably be adjustable end might well be provided to extend from a platform 25 which also carried the cooler/blower unit 12 such that the whole unit could be moved relativaly easily from one extruder to another.

The inner edges 18 of the iris 17 also act as guides for the tubular film 7 and can ba so close thereto that approximately 75% of the air fad to the plenum 20 can ba extracted through the plenum 22.

It will be appreciated that the epparatus described can heve the edvanteges that tha rate of production of film can ba increased without the film still being sticky when it reaches the pinch rollers 8. Alternetively the height of the pinch rollers 8 above the extruder 1 can be reduced for the same production rate. The conditions within the ennular space 11 can be much more stable than in an open factory erea such thet the quality of the film can ba more consistent. The epparatus can be portable end can be applicable not only to new but also to existing extruders. The epparatus can be produced without expensive tooling costs.

CLAIMS

1. A method of cooling an expended tube of extruded plastics material comprising surrounding et leest e portion of the expended tuba, intermediete the position of extrusion of the extruded tube of the plastics meterial end pinch rolls between which the cooled end expanded tube is passed, by e tubular column; supplying cooling air to an annuler space between the tubular column and the expanded tube; and sealing at least one of the ends of the said ennular space to reduce leakage of cooling air therefrom.

2. Cooling apparatus for cooling an expanded tube of extruded plastics material comprising a tubular column to surround en expanded tube of extruded plastics material, means to supply cooling air to an annular space between the column and the expanded tube and at laast one end saal on the column to close off said annular space at a position or positions adjacent one or both ands of the column.

3. Cooling epparatus according to claim 2, in which en end seel is provided at each end of the column and each end seal comprises an adjustable iris in the form of an annuler member heving a plurality of parts which are relatively moveble such thet the inner diameter of the annular member is adjustable in size.

4. Cooling apparatus according to claim 2 or claim 3, in which the means to supply cooling eir to tha annuler space comprise a

cooler unit, e fan to cause flow of air through the cooler unit and hoses connecting the cooler unit to opposite ends of the column.

5. Cooling epparatus according to claim 4, when appendant to cleim 3, in which at the lower end of the column, above the lower edjusteble iris thereof, a plenum is provided with upwerdly directed outlets, the outlets being so angled that jets of air flowing from the plenum into the annular space cause a toroidal flow of air in the ennular space in an upward direction, and e collector is provided at the upper end to extract the air from the column and feed it back to the fan cooler unit.

6. Cooling apparatus according to any one of claims 2 to 5, in which the column is split longitudinelly to form two relatively hinged together parts such that it can be opened up to allow the extruded tube to be drawn through when first starting an extruding operation.

7. Cooling apperatus according to any one of cleims 2 to 6 in which the column is mounted on legs which are edjusteble in height.

8. Cooling epparatus according to claim 4, or any one of claims 5 to 7 when appendant to claim 4, mounted as a wheeled unit together with the fan and cooler unit whereby it can relatively easily be moved to provide cooling for different extruders.

9. Cooling apparatus according to any one of claims 2 to 8, in which the column is provided with en insulating jacket to prevent undesirable heat gain of the column from the surrounding atmospheric eir.

10. A method of cooling an expanded tube of extruded plastics materiel as claimed in claim 1 and substantially as hereinbefore described.

11. Cooling apparatus for cooling an expanded tube of extruded plastics material substantially es hereinbefore described and illustrated with reference to the accompanying drawings.

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